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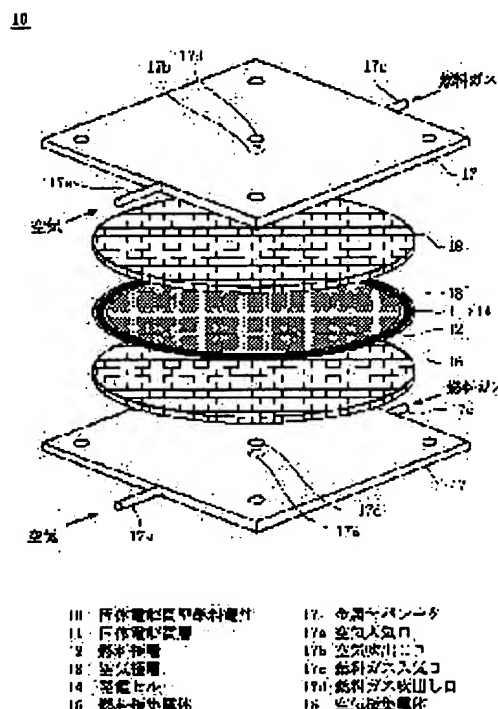
(54) SOLID ELECTROLYTIC FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a solid electrolytic fuel cell wherein electric resistances of a fuel supply plate and of an air supply plate do not increase and electric power generating efficiency can be improved even if actuated at low- temperatures.

SOLUTION: This is the solid electrolytic fuel cell wherein an electric power generating cell 14 composed of the solid electrolyte layer 11 and of a fuel electrode layer 12 and an air electrode layer 13 arranged and installed at both faces of this solid electrolyte layer, and a metal separator 17 are equipped, respectively, constituted so that the fuel gas is supplied to the fuel electrode layer and an oxidizer gas containing oxygen to the air electrode layer. In this battery, the metal separator is

plated by either of silver or silver alloy. Further an air electrode current collector 18 is either a porous material 18a composed of silver or silver alloy, or a porous material comprised that a porous material of a metal except silver or silver alloy is coated by silver or silver alloy.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the fuel cell of the solid oxide type which has the generation-of-electrical-energy cell constituted by pinching an electrolyte layer by the fuel electrode layer and the air electrode layer.

[0002]

[Description of the Prior Art] A fuel electrode charge collector is stuck to the generation-of-electrical-energy cell which consists of the fuel electrode layer and air electrode layer which were arranged in both sides of a solid electrolyte layer and this solid electrolyte layer, and a fuel electrode layer, an air pole charge collector is stuck to an air electrode layer, respectively, and the solid acid ghost mold fuel cell of the structure which carried out the laminating through the separator is known. Conventionally, since operating temperature is high and it needs to use ceramics like lanthanum chromite for structural members, such as a separator, with about 1000 degrees C, this kind of solid acid ghost mold fuel cell lacks in dependability. Therefore, development of the low-temperature actuation mold solid electrolyte fuel cell which can use a metallic material for an edge strip in recent years is furthered. The thin film of lanthanum gallate system oxide, Sc addition zirconia, and Y addition zirconia, Seria system oxide, etc. are used for a solid electrolyte layer at this low-temperature actuation mold solid electrolyte fuel cell. By using these ingredients, operating temperature can be reduced to about 700 degrees C, and a metallic material can be used now for edge strips, such as a separator. Stainless steel, a nickel radical heat-resistant alloy, or a cobalt base alloy is used for the separator of this low-temperature actuation fuel cell. [0003] On the other hand, although a charge collector ingredient is one of the important members which influence the generation-of-electrical-energy engine performance of a fuel cell, mesh-like platinum is conventionally used in a tentative way as a charge collector ingredient. This platinum mesh has the one where a mesh is finer in the inclination for the good engine performance to be obtained.

[0004]

[Problem(s) to be Solved by the Invention] However, although, as for the above-mentioned conventional metal separator material, a front face came to be covered with a chromic-acid ghost coat by 700-degree C conditions for example, among air, this chromic-acid ghost had the property in which electric resistance became large, when the elevated temperature showed conductivity and temperature fell. Therefore, when it was made to operate at about 700-degree C low temperature, using it as separator material had the fault which is too large. For this reason, even when using a metallic material for a separator and operating a fuel cell at low temperature, the ingredient with still smaller electric resistance was called for. Moreover, in the platinum charge collector, since platinum is noble metals, it is expensive, and a current collection ingredient of high performance which replaces platinum for cost reduction was desired.

[0005] Even when it is made to operate at low temperature, the electric resistance of a metal separator does not increase, but the purpose of this invention is to offer the comparatively cheap solid oxide fuel cell which may improve generating efficiency.

[0006]

[Means for Solving the Problem] Invention concerning claim 1 is amelioration of the solid oxide fuel cell equipped with the generation-of-electrical-energy cell 14 which consists of the fuel electrode layer 12 and air electrode layer 13 which were arranged in both sides of the solid electrolyte layer 11 and this solid electrolyte layer 11, and the metal separator 17 constituted so that the oxidant gas which contains fuel gas in a fuel electrode layer 12, and contains oxygen in an air electrode layer 13 could be supplied,

respectively, as shown in drawing 1 . What the metal separator 17 was galvanized for by either silver or the silver alloy has the characteristic configuration. In invention concerning claim 1, each electric resistance of the metal separator 17 can be remarkably decreased over a long time by galvanizing with either silver or a silver alloy to the metal separator 17.

[0007] Invention concerning claim 2 is a fuel cell whose metal separator 17 it is invention concerning claim 1 and is stainless steel, a nickel radical heat-resistant alloy, or a cobalt base alloy. The thermal resistance which was excellent in invention concerning claim 2 by using stainless steel, a nickel radical heat-resistant alloy, or a cobalt base alloy for a metal separator is shown.

[0008] Invention concerning claim 3 is a fuel cell whose stainless steel it is invention concerning claim 2 and is ferritic stainless steel. In invention concerning claim 3, since adhesion of ferritic stainless steel with silver is good, it is desirable as a metal base material.

[0009] invention concerning claim 4 -- claim 1 thru/or 3 -- it is invention concerning either and is the fuel cell with which the metal separator 17 was galvanized by nickel and galvanized by either silver or the silver alloy by making nickel plating into a substrate. By invention concerning claim 4, high adhesion with a metal separator, silver, or silver alloy plating is acquired by carrying out substrate plating with nickel.

[0010] Invention concerning claim 5 is a fuel cell which is invention concerning claim 1, and is porous body 18a which the air pole charge collector 18 arranged by sticking to an air electrode layer 13 becomes from silver or a silver alloy, or is the porous body which comes to cover the porous body of metals other than silver or a silver alloy with silver. In invention concerning claim 5, it is the porous body which an air pole charge collector turns into from silver or a silver alloy, or is the porous body which comes for silver to cover the porous body of metals other than silver or a silver alloy. It is returned into a high-temperature-oxidation ambient atmosphere 200 degrees C or more, and a solid-state metal phase is a stabilization phase, and silver dissolves oxygen slightly and has the property in which oxygen tends to diffuse the interior. On the other hand, the platinum used conventionally hardly dissolves oxygen. For this reason, the engine performance improves by using silver for the quality of the material of an air pole charge collector.

[0011] It is invention concerning claim 5, the air charge collectors 18 are metal base materials other than silver or a silver alloy, and invention concerning claim 6 is the fuel cell with which the metal base material was galvanized by nickel and galvanized by silver by making nickel plating into a substrate. By invention concerning claim 6, the high adhesion of a metal base material and silver is acquired by carrying out substrate plating with nickel.

[0012] Invention concerning claim 7 is a fuel cell which is invention concerning claim 5 and is the sponge-like metal porous body in which porous body 18a has three-dimension skeletal structure. Invention concerning claim 8 is invention concerning claim 5 or 7, and as shown in drawing 2 , porous body 18a is the fuel cell reinforced with mesh-like metal body 18b. In invention concerning claim 8, porous body 18a is weak, and since it may be easy to be crushed, the configuration of an air pole charge collector can be more strongly held by reinforcing with mesh-like metal body 18b in this case.

[0013] Invention concerning claim 9 is invention concerning claim 8, and is a fuel cell which comes to cover metal base materials other than silver or a silver alloy with silver or a silver alloy by mesh-like metal body 18b consisting of silver or a silver alloy. In invention concerning claim 9, the cell engine performance can be stabilized by constituting a mesh-like metal body according to the same quality of the material as an air pole charge collector.

[0014] It is invention concerning claim 9, mesh-like metal body 18b is metal base materials other than silver or a silver alloy, and invention concerning claim 10 is the fuel cell with which the metal base material was galvanized by nickel and galvanized by silver by making nickel plating into a substrate. By invention concerning claim 10, the high adhesion of a metal base material and silver is acquired by carrying out substrate plating with nickel.

[0015] invention concerning claim 11 -- claim 1 thru/or 10 -- it is the fuel cell which is invention concerning either and is the conductor chosen from the group which the solid electrolyte layer 11 becomes from a lanthanum gallate system solid acid ghost, Sc fully stabilized zirconia, Y fully stabilized zirconia, or Seria system oxide. If these conductors are used for the solid electrolyte layer 11, a fuel cell with an operating temperature of less than 950 degrees C is easily realizable.

[0016]

[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained. As shown in drawing 1 , a solid oxide fuel cell 10 is equipped with the metal separator 17 constituted so that the oxidant gas which contains fuel gas in the generation-of-electrical-energy cel 14 which consists of the

fuel electrode layer 12 and air electrode layer 13 which were arranged in both sides of the solid electrolyte layer 11 and this solid electrolyte layer 11, the fuel electrode charge collector 16, the air pole charge collector 18, and a fuel electrode layer 12, and contains oxygen in an air electrode layer 13 could be supplied, respectively, and it is constituted so that it may operate at less than 950 degrees C. The metal separator 17 is formed with metals other than silver or a silver alloy.

[0017] The solid electrolyte layer 11 is formed with a lanthanum gallate system solid acid ghost, Sc fully stabilized zirconia, Y fully stabilized zirconia, or Seria system oxide. For example, production of a lanthanum gallate system solid acid ghost is performed by the following approach. First, each powder of La_2O_3 , SrCO_3 and Ga_2O_3 , and MgO and CoO is prepared as raw material powder. Weighing capacity of these raw material powder is carried out, respectively so that it may be set to $\text{La}_{0.5}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.15}\text{Co}_{0.05}\text{O}_3$, each powder is mixed and preliminary baking of this mixture is carried out at 1100 degrees C. By pulverizing the acquired temporary-quenching object, adding the usual binder, a solvent, etc. and grinding with a ball mill, a slurry is produced and this slurry is fabricated to a green sheet with a doctor blade method. The fabricated green sheet is fully dried in air, it starts in a predetermined dimension, and this is sintered at 1450 degrees C. Thereby, a lanthanum gallate system solid acid ghost is obtained. A doctor blade method is one of the approaches of casting in the shape of a sheet, and is the approach of controlling the thickness of a sheet to a precision here by adjusting spacing of the knife edge and carrier which are called a doctor blade in the thickness of the slip which carries and is carried on carriers, such as a carrier film and an endless belt. Moreover, production of Sc fully stabilized zirconia is performed by the following approach. Let ZrOCl_2 and Sc_2O_3 be start raw materials first. Subsequently, Sc_2O_3 of the specified quantity is added to monoclinic system ZrO_2 sol which hydrolyzed ZrOCl_2 water solution as a nitric-acid water solution, a urea is added, it holds at 90 degrees C and homogeneity precipitate is carried out. Next, temporary quenching of this precipitate is carried out at 600 degrees C. This temporary-quenching object is calcinated at 1400 degrees C for 1 hour. Thereby, Sc fully stabilized zirconia is obtained.

[0018] A fuel electrode layer 12 is constituted by metals, such as nickel, or is constituted by cermets, such as nickel-YSZ (20nickel dope Y_3 stabilization ZrO_2). Or it is formed of a mixture with the compound expressed with nickel and general formula (1): $\text{Ce}_{1-m}\text{DmO}_2$. however, one sort or two sorts or more of elements chosen from the group which D becomes from Sm, Gd, Y, or calcium in the above-mentioned general formula (1) -- it is -- m -- the atomic ratio of D element -- it is -- 0.05 to 0.4 -- it is preferably set as the range of 1-0.3. An air electrode layer 13 is formed with the oxide ion conductor shown by general formula (2): $\text{Ln}_1\text{1-xLn}_2\text{xEl-yCo}_3\text{O}_3\text{+d}$. However, in the above-mentioned general formula (2), Ln_1 is the element of either La or Sm and both sides, Ln_2 is the element of either Ba, calcium or Sr and both sides, and E is the element of either Fe or Cu and both sides. Moreover, x is the atomic ratio of Ln_2 , exceeds 0.5 and is set as less than 1.0 range. y is the atomic ratio of Co element, exceeds 0 and is preferably set as or more 0.5 1.0 or less range 1.0 or less. d is set as or more -0.5 0.5 or less range. The generation-of-electrical-energy cel 14 forms a fuel electrode layer 12 in one side of the solid electrolyte layer 11, forms an air electrode layer 13 in one side of the opposite side of the solid electrolyte layer 11 further, and is produced by baking at 1000 degrees C.

[0019] The fuel electrode charge collector 16 is a porous body which consists of platinum, nickel, or silver. The air pole charge collector 18 is porous body 18a which consists of silver or a silver alloy, or is a porous body which comes to cover the porous body of metals other than silver or a silver alloy with silver. This porous body 18a is a sponge-like metal porous body which consists of a frame part and pore and has the three-dimensional structure, as shown in the partial enlarged drawing of drawing 2. This porosity has 60 - 97% of desirable range. Silver is returned into an oxidizing atmosphere in about 200-degree-C or more less than 950-degree C temperature requirement, and a solid-state metal phase turns into a stabilization phase. Therefore, an oxide skin is not formed in less than 950-degree C 200-degree-C or more temperature field, but the porous body which a front face becomes from silver is a good conductor. However, if the solid acid ghost fuel cell incorporating the air pole charge collector which consists of a silver porous body is operated at less than 950 degrees C, an oxide film will not be generated on the front face of the air pole charge collector which consists of a silver porous body, but since oxygen is dissolved at an elevated temperature, silver begins to melt at about 950 degrees C. Therefore, as for the operating temperature of the solid acid ghost fuel cell which incorporated the porous body which comes to cover with silver metal base materials other than the porous body which consists of silver or a silver alloy, silver, or a silver alloy as an air pole conductor, it is desirable that it is less than 950 degrees C. It is less than 930 degrees C preferably. Since the high adhesion of a metal base material and silver is acquired by galvanizing metal base materials other than silver or a silver alloy with

nickel, and galvanizing with silver by making this nickel plating into a substrate, it is desirable. Moreover, a porous body is reinforced with a mesh-like metal body. this mesh-like metal body -- silver or a silver alloy -- or it is the metal body covered with silver or a silver alloy in metal base materials other than silver or a silver alloy. As for the metal member used by the porous bodies and metal bodies other than silver or a silver alloy which come to cover a metal base material with silver or a silver alloy, nickel, stainless steel, a nickel radical alloy, a cobalt base alloy, etc. are mentioned. Since the high adhesion of a metal base material and silver is acquired by galvanizing a metal base material with nickel and galvanizing with silver by making this nickel plating into a substrate, it is desirable. The opening of a mesh-like metal body is in the range of 0.5-1000 micrometers.

[0020] the case where the oxygen in air generally uses as an air pole charge collector the silver with which oxygen is contained in an air electrode layer when a receipt and oxygen ion (O_2^-) are generated by the air pole charge collector in an electron -- current collection -- since there is work which the oxygen contained inside of the body makes promote generation of the oxygen ion in a current collection body surface, oxygen ion can be quickly moved from a current collection body surface. Moreover, migration of the further oxygen ion becomes prompt by the rise of the exchange current density of a charge collector and an electrode. furthermore, dissociation ($O_2 \rightarrow O_2^-$) of oxygen and ionization ($O + 2e^- \rightarrow O_2^-$) -- air pole current collection -- it is thought that it is because it promotes by the oxygen which dissolved inside of the body.

[0021] The manufacture approach of the porous body used for an air pole charge collector and a fuel electrode charge collector is explained. In addition, the gestalt of this operation explains the manufacture approach of the air pole charge collector which consists of a virgin silver porous body. First, virgin silver atomization powder with a mean particle diameter of 2 micrometers is prepared. This virgin silver atomization powder is powder obtained by dissolving virgin silver with the usual fusion furnace, and atomizing the obtained virgin silver molten metal (atomize). Furthermore, as n-hexane and a surface active agent, as sodium dodecylbenzenesulfonate (it is called DBS sodium DodecylBenzenSulfon ate and the following.) and a water-soluble-resin binder, a glycerol is prepared as the hydroxypropyl methylcellulose (it is called HPMC HydroxyPropylMethylCellulose and the following.) and a plasticizer, and distilled water is prepared as water as an organic solvent, respectively.

[0022] Subsequently, after inserting virgin silver atomization powder and HPMC (water-soluble-resin binder) in a strong shearing-die kneading machine and kneading them for 30 minutes, 50% of the weight of the total amount of distilled water which must be added is added and kneaded. Furthermore, the mixed slurry of the presentation which consists of virgin silver atomization powder 50.0 mass %, n-hexane 1.5 mass %, HPMC5.0 mass %, DBS2.0 mass %, and glycerol 3.0 mass % is produced by adding n-hexane (organic solvent), DBS (surfactant), and the glycerol (plasticizer) which are other additives in the remaining 50 % of the weight list of distilled water, and kneading in it for 3 hours. The remaining presentation is distilled water. Next, a Plastic solid with a thickness of about 1mm is produced for this mixed slurry with a doctor blade method, and a virgin silver porous body plate is produced by performing foaming, cleaning, and sintering on the conditions which show this Plastic solid in the following table 1. The thickness of a virgin silver porous body plate has about 0.7 goodmm.

[0023]

[Table 1]

| | 発泡条件 | 脱脂条件 | 焼結条件 |
|------|------|------|------|
| 雰囲気 | — | 空气中 | 空气中 |
| 温度 | 90% | — | — |
| 温度 | 35℃ | 450℃ | 910℃ |
| 保持時間 | 10分 | 60分 | 120分 |

[0024] It starts in predetermined magnitude from this virgin silver porous body plate, and the virgin silver porous body which has 92 - 97% of porosity is obtained. An air pole charge collector is obtained by carrying out skin pass rolling of this porous body and the two mesh-like metal bodies in piles, and unifying.

[0025] The metal separator 17 is formed from metals other than silver or a silver alloy. This metal separator is galvanized by either silver or the silver alloy. By performing plating of silver or a silver alloy to a metal separator, electric resistance can be remarkably decreased over a long time. Adhesion with the metal separator 17, silver, or a silver alloy improves by galvanizing the metal separator 17 with nickel and galvanizing with silver or a silver alloy by making this nickel plating into a substrate. As for metal separator material, stainless steel, a nickel radical heat-resistant alloy, or a cobalt base alloy is

mentioned. As stainless steel, SUS430 (18 Cr-Fe), SUS310S (20nickel-25 Cr-Fe), As a nickel radical heat-resistant alloy, SUS316 (18Cr-12nickel-2.5 Mo-Fe) etc. Inconel 600 (15.5Cr-7 Fe-nickel), Inconel 718 (19Cr-3Mo-19 Fe-nickel), The HEINZU alloy 214 (16Cr-2Fe-4.5 aluminum-nickel), the HEINZU alloy 230 (16Cr-2Mo-14 W-nickel), As cobalt base alloys, such as Hastelloy C-22 (22Cr-13Mo-3W-4 Fe-nickel), ULTMET (26Cr-5Mo-2W-3Fe-9 nickel-Co), the HEINZU alloy 188 (22Cr-14.5 W-Co), etc. are mentioned, respectively. Since adhesion with silver has good ferritic stainless steel, stainless steel is desirable. Electroplating is mentioned as an approach of galvanizing a metal separator with silver or a silver alloy. This electroplating is the surface treatment approach of depositing a metal electrochemically on a metal or a nonmetal front face (electrodeposition). The metal separator 17 has air intake air opening 17a and fuel gas intake air opening 17c in that flank, and has 17d of fuel gas exit cones which lead air exit-cone 17b which leads the air introduced into this air intake air opening 17a to an air electrode layer 13, and the fuel gas introduced into fuel gas intake air opening 17c to a fuel electrode layer 12, respectively.

[0026] Thus, actuation of the constituted solid oxide fuel cell is explained. If fuel gas (H₂, CO, etc.) is introduced into fuel gas intake air opening 17c, the pore in the fuel electrode charge collector 16 will be passed, and a fuel electrode layer 12 will be supplied promptly. On the other hand, if air is introduced into air intake air opening 17a, the pore in the air pole charge collector 18 will be passed, and an air electrode layer 13 will be supplied promptly. The oxygen supplied to the air electrode layer 13 reaches near the interface with the solid electrolyte layer 11 through the pore in an air electrode layer 13, receives an electron from an air electrode layer 13 in this part, and is ionized by oxide ion (O²⁻). If this oxide ion carries out spreading diffusion of the inside of the solid electrolyte layer 11 toward the direction of a fuel electrode layer 12 and reaches near the interface with a fuel electrode layer 12, it will react with fuel gas in this part, will produce a resultant (H₂O and CO₂ grade), and will emit an electron to a fuel electrode layer 12. By taking out this electron with the fuel electrode charge collector 16, a current occurs and power is obtained.

[0027]

[Example] Next, the example of this invention is explained with the example of a comparison.

<Examples 1-3> The lanthanum gallate system solid acid ghost was formed first, using 0.05OLa0.5Sr0.2Ga0.8Mg0.15Co3 powder as a fixed electrolyte layer. The silver porous body which has three-dimension skeletal structure using the manufacture approach of the porous body mentioned above was manufactured. The expanded metal of silver was prepared as reinforcing materials of a silver porous body. What carried out skin pass rolling of the two expanded metals of this silver porous body and silver in piles, and was unified was used as the air pole charge collector. The nickel porous body was used for the fuel electrode charge collector. The electrolyte layer was pinched by the fuel electrode layer and the air electrode layer, and the single cel of a generation-of-electrical-energy cel was constituted. Subsequently, SUS430 (example 1), Inconel 600 alloy (example 2), and the ULTMET alloy (example 3) were prepared as metal separator material, respectively. These metal separator material was galvanized with electroplating, the front face was galvanized 2-5 micrometers in thickness with silver, and it considered as the metal separator. The two-step laminating of the single cel was carried out, it carried out the two-step cel stack, this two-step cel stack was pinched with the metal separator, and the fuel cell was obtained.

[0028] Silver plating was not performed to the metal separator of the <examples 1-3 of comparison> examples 1-3, but the fuel cell was produced like examples 1-3 using the respectively same metal separator as examples 1-3 except having used the platinum porous body of 200 meshes as an air pole charge collector.

The fuel cell was produced like examples 1-3 using the respectively same metal separator as examples 1-3 except having formed Sc fully stabilized zirconia in the solid electrolyte layer using <examples 4-6> Sc₂O₃-ZrOCl₂ powder.

Silver plating was not performed to the metal separator of the <examples 4-6 of comparison> examples 4-6, but the fuel cell was produced like examples 4-6 using the respectively same metal separator as examples 4-6 except having used the platinum porous body of 200 meshes as an air pole charge collector.

[0029] The fuel cell was produced like examples 1-3 using the respectively same metal separator as examples 1-3 except having formed Y fully stabilized zirconia in the solid electrolyte layer using < example 7 - 9> 8%Y₂O₃ dope ZrO₂ powder.

Silver plating was not performed to the metal separator of the <examples 7-9 of comparison> examples 7-9, but the fuel cell was produced like examples 7-9 using the respectively same metal separator as

examples 7-9 except having used the platinum porous body of 200 meshes as an air pole charge collector.

[0030] The fuel cell was produced like examples 1-3 using the respectively same metal separator as examples 1-3 except having formed the Seria system oxide in the solid electrolyte layer using <examples 10-12> Ce0.9Gd0.1O1.95-X powder.

Silver plating was not performed to the metal separator of the <examples 10-12 of comparison> examples 10-12, but the fuel cell was produced like examples 10-12 using the respectively same metal separator as examples 10-12 except having used the platinum porous body of 200 meshes as an air pole charge collector.

[0031] The generating mode of the hydrogen gas was carried out at 700 degrees C as a part for 3 cc/cm2/, and oxidant gas for 500 hours by having made the fuel cell of the <comparative-evaluation> examples 1-12 and the examples 1-12 of a comparison into fuel gas, supplying air by part for 15 cc/cm2/, respectively, and the performance evaluation of the generation-of-electrical-energy output of each fuel cell after 500-hour progress was performed. Here, the potential difference between a fuel electrode charge collector and an air pole charge collector was adjusted to 0.7V, and the generation-of-electrical-energy engine performance measured it, and evaluated it from the value which calculated the average of the output per single cel. The generation-of-electrical-energy engine performance of the fuel cell of examples 1-12 and the examples 1-12 of a comparison is shown in Table 2, respectively.

[0032]

Table 2]

| | 金属 セパレータ | 銀めっき | 集電体 | | 固体 電解質層 | 単セル出力 の平均値 [mW/cm ²] |
|-------|-------------|------|------------------|-------------|---------------------|--|
| | | | 空気極 | 燃料極 | | |
| 実施例 1 | SUS430 | 有 | 銀多孔体 + 補強材 | ニッケル 多孔体 | ランタンガレート系 固体酸化物 | 465 |
| " 2 | インコネル600 | 有 | | | | 470 |
| " 3 | ULTMET | 有 | | | | 472 |
| " 4 | SUS430 | 有 | | | S c 安定化 ジルコニア | 160 |
| " 5 | インコネル600 | 有 | | | | 219 |
| " 6 | ULTMET | 有 | | | | 221 |
| " 7 | SUS430 | 有 | | | Y 安定化 ジルコニア | 126 |
| " 8 | インコネル600 | 有 | | | | 129 |
| " 9 | ULTMET | 有 | | | | 131 |
| " 10 | SUS430 | 有 | | | ガドリウム添加 セリウム系酸化物 | 231 |
| " 11 | インコネル600 | 有 | | | | 240 |
| " 12 | ULTMET | 有 | | | | 241 |
| 比較例 1 | SUS430 | 無 | 白金 多孔体 | ニッケル 多孔体 | ランタンガレート系 固体酸化物 | 298 |
| " 2 | インコネル600 | 無 | | | | 295 |
| " 3 | ULTMET | 無 | | | | 290 |
| " 4 | SUS430 | 無 | | | S c 安定化 ジルコニア | 106 |
| " 5 | インコネル600 | 無 | | | | 145 |
| " 6 | ULTMET | 無 | | | | 142 |
| " 7 | SUS430 | 無 | | | Y 安定化 ジルコニア | 81 |
| " 8 | インコネル600 | 無 | | | | 84 |
| " 9 | ULTMET | 無 | | | | 84 |
| " 10 | SUS430 | 無 | | | ガドリウム添加 セリウム系酸化物 | 163 |
| " 11 | インコネル600 | 無 | | | | 162 |
| " 12 | ULTMET | 無 | | | | 166 |

[0033] Silver plating of the metal separator was not carried out, but silver plating was performed to the metal separator using the respectively same electrolyte ingredient compared with the examples 1-12 of a comparison which used the platinum porous body for the air pole charge collector, and the output average per single cel had exceeded, respectively in the examples 1-12 which used the silver porous body for the air pole charge collector so that more clearly than Table 2.

[0034]

[Effect of the Invention] Since according to this invention it was constituted by the metal separator which consists of metal base materials other than silver or a silver alloy and the metal separator was galvanized by either silver or the silver alloy as stated above, electric resistance can be remarkably decreased over a long time. Moreover, since it is the porous body which an air pole charge collector turns into from silver or a silver alloy or is the porous body which comes to cover metal base materials other than silver or a silver alloy with silver or a silver alloy, oxygen is dissolved inside silver and oxygen tends to diffuse the interior. Consequently, even when it is made to operate at low temperature, the electric resistance of a metal separator cannot increase, but generating efficiency can be improved.

[Translation done.]

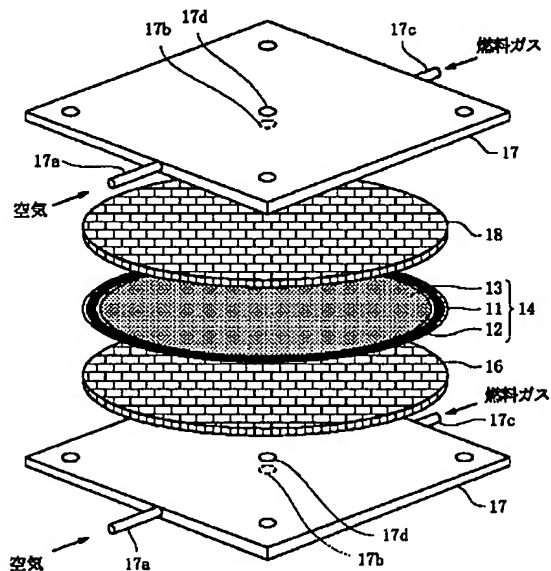
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DRAWINGS

[Drawing 1]
10



- | | |
|---------------|--------------|
| 10 固体電解質型燃料電池 | 17 金属セパレータ |
| 11 固体電解質層 | 17a 空気入気口 |
| 12 燃料極層 | 17b 空気吹出し口 |
| 13 空気極層 | 17c 燃料ガス入気口 |
| 14 発電セル | 17d 燃料ガス吹出し口 |
| 16 燃料極集電体 | 18 空気極集電体 |

[Drawing 2]

